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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Michael A. Bernadicou
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025-1030

EXAMINER

HU, HENRY S

ART UNIT	PAPER NUMBER
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1713

DATE MAILED: 09/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/071,743

Applicant(s)

JAYARAMAN ET AL.

Examiner

Henry S. Hu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on RCE of 7-16-2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4,6-14,16 and 17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4,6-14,16 and 17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 7-16-2004.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

1. It is noted that **RCE of this application 10/071,743 filed on July 16, 2004 was received. Claim 1 was amended, and Claims 5, 18-20 and 29 were cancelled.** It is noted that Claims 15 and 21-28 were previously cancelled. **Claims 1-4, 6-14 and 16-17 are thereby pending now.**
An action follows with new set of rejections.

DETAILED ACTION

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. The limitation of parent **Claim 1** of the present invention relates to a thermal interface material comprising a phase change polymer; a solder material having a melting temperature approximately between 100 and 250° C; and a plurality of thermally conductive non-fusible particles, the solder material interconnecting the non-fusible after the thermal interface material is heated to the melting temperature of the solder material. See other limitations of dependent **Claims 2-4, 6-14 and 16-17**.

4. Claims 1-4, 6-14 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen (US 6,451,422) in view of Nelson et al. (US 5, 328,087).

Regarding the limitation of parent **Claim 1**, **Nguyen** discloses a thermal interface material composition comprising (A) rubber, (B) a phase change material such as paraffin waxes or polymers waxes, or mixture thereof (column 2, line 27-34), and (C) at least one thermally conductive filler selected from (c-1) as alloys, silver, aluminum or copper in the amount of at least 50% by weight and (c-2) as boron nitride, a carbon fiber or a metal coated carbon fiber in the amount of at least 20% by weight (column 2, line 11 – column 4, line 18; column 1, line 51-64). It is noted that Nguyen has applied both thermal conductive fillers, (c-1) and (c-2), together as shown in Table 1 (see column 4, line 44-67).

5. With respect to the limitation of using a fusible filler solder material having a melting point of 100-250 °C, Nguyen is silent of the alloy in (c-1) is the claimed solder. It is noted that an alloy is a substance composed of two or more metals or a metal and a nonmetal intimately

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united usually by being fused together and dissolving in each other when molten (see Webster Dictionary). In a closer comparison, the molten temperature of an alloy may be over 250 °C. Therefore the claimed solder is always an alloy, but an alloy may be not related to the claimed solder. Nelson et al. teach that in the preparation of a thermally and electrically conductive adhesive material, metallic fillers such as solder or fusable alloy can be liquid at the cure temperature (160 to 250 °C) of adhesive, the advantage is to enhance the surface contact and later solidify at room temperature (column 2, line 3-16; column 3, line 30-54).

In light of the fact **both Nguyen and Nelson have prepared thermal conductive materials with metallic filler**, one having ordinary skill in the art would therefore find it obvious to modify Nguyen's thermal interface material composition by specifically using a fusable metal alloy or alloy having a melting temperature of 160-250 °C as (c-1) filler to be combine with the non-fusible filler (c-2) as taught by Nelson et al., with an advantages as such a combination in fillers will enhance the surface contact and later solidify at room temperature so that to produce an effective thermal interface material useful to transfer the excess heat dissipated across physical interface in electronic devices, and thereby producing a persistent, reliable and long-lasting product.

6. Regarding **Claim 2**, Nguyen discloses in the above the rubbers in (A) include EPR, EPDM and polybutadiene (column 2, line 11-26) which are non-fusible phase polymers.

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Regarding **Claim 3**, Nguyen discloses the melting points of waxes in (B) are in the range of 20-100 °C (column 1, line 45-47).

Regarding **Claim 4**, as Nguyen disclosed in Claim 1, non-fusible fillers such as (c-1) silver and copper as well as (c-2) boron nitride, a carbon fiber and a metal-coated carbon fiber can be included as co-fillers.

Regarding **Claims 10 and 16**, the metal alloy's melting point reads on the claimed limitation of 100-250 °C. The fusible alloy or solder certainly includes mixed metals in the nature.

Regarding **Claim 6**, the filler can be added in the form of powder since it has a particle size of 0.5-25 μm (column 1, line 61-64). Regarding **Claim 7**, a mesh can be placed as reinforcement (column 5, line 59-60). Regarding **Claim 8**, the thermal conductivity disclosed on Tables 1 and 2 read on the limitation of Claim 8 (column 4-6).

Regarding **Claims 9, 11-14 and 17**, Nguyen discloses that the fiber glass mat expanded metals such as silicon, copper, aluminum, etc. and aluminum mesh can be included in conventional amount, which reads on the claimed limitation of 50-99 wt% (column 5, line 65-67; column 4, line 3-18).

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7. Claims 1-4, 6-14 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Salyer (US 4,711,813) in view of Nguyen (US 6,451,422) and Nelson et al. (US 5,328,087).

Regarding the limitation of parent **Claim 1**, Salyer discloses that a thermal energy storage composite comprises (A) a phase change material such as polyethylene wax (column 7, line 31-33; abstract, line 1-4), and (B) flame-resistant fillers (column 8, line 18-25). Salyer further discloses the flame-resistant fillers (B) can be selected from antimony oxide, a blend of pentaerythritol/monoammonium phosphate, and the mixture thereof (column 8, line 18-25). Salyer further discloses that such a composite is useful as a fireretardant or a phase change material (column 8, line 26-29).

8. The above discussion of the disclosures of the prior art of Nguyen and Nelson of this office action is incorporated here by reference. With respect to the limitation of using a solder material having a melting point of 100-250 °C, it is noted that Salyer's pentaerythritol in (B) only read on "fusible" limitation since it is an organic compound having a melting point. However, Salyer is silent about including fusible solder or metal alloy to be combine with the non-fusible filler, which are all taught by a combination of Nguyen and Nelson. The advantage is such a combination in fillers will enhance the surface contact and later solidify at room temperature (see Nelson at column 2, line 3-16; column 3, line 30-54). Additionally, it would **produce an effective thermal interface material useful to transfer the excess heat dissipated across physical interface in electronic devices** (see Nguyen at column 1, line 4-8).

Therefore, one having ordinary skill in the art would find it obvious to modify Salyer's composition by including fusible solder or metal alloy to combine with the non-fusible filler as taught by Nguyen and Nelson, with an advantages as such a combination in fillers will enhance the surface contact and later solidify at room temperature and produce an effective thermal interface material useful to transfer the excess heat dissipated across physical interface in electronic devices, and thereby producing a persistent, reliable and long-lasting product.

9. Regarding **Claim 2**, Salyer discloses such phase change material in (A) can be incorporated into the concrete walls or floors of buildings to absorb solar energy (column 1, line 33-37). It is conventional or by teaching of Nguyen to include some polymeric rubbery material as part of floor and wall.

Regarding **Claim 3**, Salyer discloses the melting points of polyethylene waxes in (A) are in the range of 42-70 °C (column 6, line 63 – column 7, line 7).

With the teaching of Nguyen and Nelson, the remaining **Claims 4, 6-14 and 16-17** are thereby rejected.

Conclusion

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10. The prior art made of record and not relied upon is considered pertinent to applicants' disclosure. The following references relate to a thermal interface material comprising a phase change polymer, a solder material and a plurality of thermally conductive non-fusible particles:


US Patent No. **5,290,904 to Colvin et al.** disclose a thermal shield comprising a phase change material embedded within a base material such as a silicone rubber (abstract, line 1-9; column 2, line 30-32). Various phase change materials such as **n-Octacosane having low melting point** can be used (column 2, line 39-62). Some silicon rubber may be included as a binder embedded with the phase change material (column 2, line 30-32). However, **Colvin fails to teach or fairly suggest including a fusable solder or alloy material in the composition.** Therefore, Colvin fails to teach the claimed limitation of present application.

11. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Henry S. Hu whose telephone number is **(571) 272-1103**. The examiner can be reached on Monday through Friday from 9:00 AM –5:00 PM.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu, can be reached on (571) 272-1114. The fax number for the organization where this application or proceeding is assigned is (703) 872-9306 for all regular communications.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Henry S. Hu

August 30, 2004


DAVID W. WU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700